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(54) **OUTER LAYER MATERIAL OF MULTILAYER PRINTED WIRING BOARD AND PRODUCTION THEREOF.**

(57) Two aluminum-copper foils are joined with their aluminum surfaces in contact for use as an outer layer material (20) of a multilayer printed wiring board. In producing this board, an outer layer material, a prepreg (2), an inner layer material (1), a prepreg (3) and an outer layer material (21) are built up in this order. Therefore, the aluminum portion of the outer layer material (20) works as a conventional mirror plate and a dummy plate. Further,the aluminum surfaces can be easily released from each other and work as conventional mold releasing films. The outer layer material (20) has aluminum surfaces tightly adhered to each other and does not permit resin scums or foreign matter to adher thereto unlike that of the prior art, this structure further prev nts scars or damag caused by impact from developing. Moreover,since no mirror plate is used, th operation steps can b simplified and th built-up operation can be easily and automatically carri d out. It is also possible to use plastic metal foils of aluminum alloy, copper, brass, soft steel, lead alloy and the like instead of the aluminum foil.

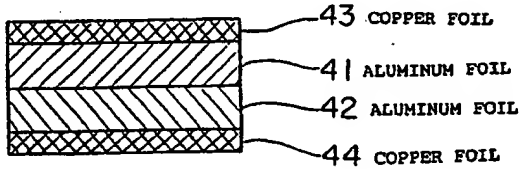

Fig. 2

EP 0 411 142 A1

OUTER LAYER MATERIAL FOR MULTILAYER PRINTED WIRING BOARD AND METHOD OF MANUFACTURING MULTILAYER PRINTED WIRING BOARD

Technical Field

The present invention relates to a laminating material of outer layer for a multilayer printed wiring board, and a method of manufacturing such a multilayer printed wiring board.

Background Art

The tendency of modern electronic devices is toward a smaller size, a lower profile, and more functions, and hence various components such as various IC units used in such electronic devices are required to be smaller in size, lower in profile, and have more functions. In view of the tendency, it is desired that printed wiring boards on which the electronic components are to be mounted be smaller in size and higher in density. One approach to the requirement is to use a multilayer printed wiring board which has wiring patterns in a multiple of layers.

FIG. 5 shows a conventional method of manufacturing a multilayer printed wiring board. The conventional method of manufacturing a multilayer printed wiring board will hereinafter be described with reference to FIG. 5. First, prepregs 2, 3 are placed on the respective upper and lower opposite sides of a dielectric laminate (inner layer laminate) 1 which has conductive wiring patterns (not shown) on its both surfaces. Then, an outer layer material 4 composed of a copper foil is placed on the upper side of the prepreg 2, and an outer layer material 5 is placed on the lower side of the prepreg 3. The inner layer 1, the prepregs 2, 3, and the outer layers 4, 5 jointly form a multilayer (four-layer) printed wiring board as a first page. A multilayer printed wiring board as a second page, which is the same construction as that of the first page printed wiring board is positioned below the first page printed wiring board. Between the first and second pages, there are disposed parting films 7, 11 and a mirror finished steel plate 9 sandwiched therebetween. The multilayer printed wiring boards which are separated by the mirror finished steel plate are stacked ranging from 5 to 12 pages, and then are sandwiched by bonding dies 16, 17 with dummy plates 12, 13 and parting films 14, 15 interposed th rebetween. The multilayer printed board stacks are then inserted between hot press plates, and pressed to laminate with heat.

In order to position the circuits on th inner layers into registry, both stacked laminates have punched through holes in the same positions, and are fixed in position by positioning pins extending through the through holes.

The above prior art is disclosed in Japanese Laid-Open Patent Publications Nos. 60-62193 and 60-65598.

The mirror finished steel plates serve to reduce thickness irregularities and minimize surface irregularities due to projecting conductive wiring patterns on the surfaces of the inner layers of the laminated multilayer printed wiring boards, and uniformize the temperature distribution in the direction in which the printed wiring boards are stacked. Therefore, the mirror finished steel plates are indispensable when the multilayer printed wiring boards are laminating with the conventional method.

The parting films are employed to prevent both the multilayer printed wiring boards and the mirror finished steel plates from being bonded due to a flow of interlayer adhesive (prepregs) while the stacks are being pressed to laminate with heat by the press plates.

The dummy plates are used to improve the temperature distribution in the direction in which the printed wiring boards are stacked, while they are being heated by the press plates.

With the conventional method, the mirror finished steel plates have to be thoroughly cleansed each time one heating and pressing cycle is finished, so that powdery foreign matter and resin refuse from the prepregs will not remain attached to the mirror finished steel plates, and the mirror finished steel plates thus cleaned are repeated used.

However, when the multilayer printed wiring boards are stacked after the mirror finished steel plates are cleansed, the outer layer materials (copper foils) are liable to be scratched or dented when they are pressed because powdery foreign matter and resin refuse from the prepregs are apt to be attached to the mirror finished steel plates, or due to surface irregularities of the mirror finished steel plates. If this happens, the wiring patterns on the multilayer printed wiring boards become defective.

According to the conventional buildup method, the parting films must be superposed on the upper and low r surfaces of each of th mirror finished steel plates. This procedure is however inefficient and complex, resulting in obstacles to product quality stability, cost reductions, and process automation. specifically, since there are many steps involved in stacking th multilayer printed wiring boards, it is difficult to automatize the process

using robots.

Disclosure of the Invention

The present invention has been made in view of the aforesaid drawbacks. It is an object of the present invention to provide an outer layer material for a multilayer printed wiring board and a method of manufacturing such a multilayer printed wiring board, with a stacking process which is simple and free of causes of defects.

To achieve the above object, there is provided in accordance with the present invention an outer layer material for a multilayer printed wiring board, comprising first and second plastic-metal-copper foils each composed of copper and a plastic metal such as an aluminum alloy, copper, brass, soft iron, a lead alloy, or the like, whose first and second plastic-metal foil sides are integrally joined together, but are easily separable from each other after lamination.

There is also provided a method of manufacturing a multilayer printed wiring board, comprising the steps of: stacking a first outer layer material of the above construction, a first prepreg, an inner layer laminate having wiring patterns on both surfaces thereof, a second prepreg, and a second outer layer material of the above construction, in the order named, thereby producing a stacked assembly.

Two plastic-metal-copper foils each composed of copper and aluminum are held back to back, with plastic-metal surfaces against each other, thereby providing an outer layer material for a multilayer printed wiring board. To manufacture a multilayer printed wiring board, an outer layer material, a prepreg, an inner layer laminate, a prepreg, and an outer layer are successively stacked or built up in the order named. The plastic-metal surface of the outer layer material serves as a mirror finished steel plate and a dummy plate which have heretofore been employed. Since the aluminum surfaces can easily be separated from each other, they perform the function of conventional parting films.

As the aluminum surfaces of the outer layer materials are held in intimate contact with each other, resin refuse or foreign matter are not attached to the aluminum surfaces, and the aluminum surfaces are prevented from being scratched or dented or otherwise made defective. Sinc any mirror finished steel plat s ar not employed themselv s, the manufacturing process is simplifi d, and the build-up operation can be automatiz d.

Brief Description of the Drawings

FIG. 1 is a view showing an embodiment of a method of manufacturing a multilayer printed wiring board according to the present invention;

FIG. 2 is a view showing the structure of an outer layer material used in the method of manufacturing a multilayer printed wiring board according to the present invention;

FIG. 3 is a view showing the laminated stacks of multilayer printed wiring boards which are taken from hot press plates after finishing the press cycle;

FIG. 4 is a view showing the multilayer printed wiring boards which are separated from the stacks; and

FIG. 5 is a view illustrating a conventional method of manufacturing multilayer printed wiring boards.

Best Mode for Carrying Out the Invention

An embodiment of the present invention will hereinafter be described with reference to the drawings.

FIG. 2 shows the structure of an outer layer material used in a method of manufacturing a multilayer printed wiring board according to the present invention. The outer layer material comprises a first aluminum-copper foil which is composed of a copper foil 43 attached under pressure or plated on one surface of an aluminum foil 41, and a second aluminum-copper foil which is composed of a copper foil 44 deposited similarly on one surface of an aluminum foil 42. The aluminum foil 41 has a thickness of about 70 μm, and the copper foil 43 has a thickness of about 18 μm. The first and second aluminum-copper foils are bonded, with their aluminum surfaces held against each other, into an integral structure by a plastic-base adhesive whose bonding strength weakens at a temperature of about 170 degrees. The aluminum surfaces can therefore be separated with ease after lamination. Even if the aluminum surfaces are joined under pressure and heat, their bonding strength may weaken at a certain temperature as with the adhesive. Alternatively, the first and second aluminum surfaces may be joined to each other by spot-welding at two or more locations on their peripheral edges. In this case, the first and second aluminum surfaces can be separated from each other when th welded regions are subsequently r moved.

Treated copper surfaces of the out r layer thus prepared may be coated with a resin such as epoxy, polyimide, or a bl nded resin th r of, for making a printed wiring board. Th thickn ss of the

aluminum foil should preferably range from about 30 to 100 μm, and the thickness of the copper foil should preferably range from about 5 to 35 μm.

Th aluminum foil may be replaced with a foil of plastic metal such as an aluminum alloy, copper, brass, soft iron, a lead alloy, or the like.

A method of manufacturing a multilayer printed wiring board using the outer layer material shown in FIG. 2 will be described below. FIG. 1 shows an embodiment of a method of manufacturing a multilayer printed wiring board according to the present invention. The method shown in FIG. 1 is a buildup manufacturing method. First, prepregs 2, 3 are placed on the respective upper and lower opposite sides of an inner layer laminate 1 which has conductive wiring patterns (not shown) on its both surfaces. Then, an outer layer material 20 of the structure shown in FIG. 2 is placed on the upper side of the prepreg 2, and an outer layer material 21 of the structure shown in FIG. 2 is placed on the lower side of the prepreg 3. The inner layer laminates 1, the prepregs 2, 3, a lower half of the outer layer material 20 (i.e., the second aluminum-copper foil composed of the aluminum foil 42 and the copper foil 44), and an upper half of the outer layer material 21 (i.e., the first aluminum-copper foil composed of the aluminum foil 41 and the copper foil 43) jointly fabricate a multilayer (four-layer) printed wiring board as a first page. A multilayer printed wiring board as a second page, which is the same construction as that of the first page printed wiring board, with a lower half of the outer layer material 21 being used as an outer layer, is positioned below the first page printed wiring board. The multilayer printed wiring boards which are parted by the outer layer materials shown in FIG. 2 are provided in stacks ranging from 1 to 24 pages, and then are sandwiched directly by bonding dies 16, 17. The multilayer printed wiring board stacks are then inserted between hot press plates, and pressed to laminate with heat.

In this embodiment, the multilayer printed wiring boards are fabricated without the need for parting films, dummy plates, and mirror finished steel plates which have heretofore been employed. Since only one unit of outer layer material 21 is required to be placed between the first and second pages, the process is simplified.

FIG. 3 shows the stacked multilayer printed wiring boards which are removed from between the hot press plates after they are laminated with heat. The inner layers and the outer layers are firmly bonded by prepregs (not shown) when pressed with heat. The stacked multilayer printed wiring boards which are taken out from between the hot press plates are then separated along the join d aluminum surfaces of the outer layers 21, 22 into individual multilayer printed wiring boards as shown in FIG. 4.

A separated multilayer printed wiring board has outer layers 20b, 21a on the opposite sides of the inner layer 1, the outer layers 20b, 21a having aluminum surfaces, respectively. These aluminum surfaces are used to allow a drill bit to be entered into the laminates easily when holes are drilled in the multilayer printed wiring board. After the drilling process, the aluminum foils are peeled off.

With the above embodiment, as described above, any dummy plates, parting films, and mirror finished steel plates which have heretofore been employed are no longer necessary, and the whole laminating processes are simplified. The process of attaching aluminum onto the surface of laminates in drilling is eliminated. Since the stacked multilayer printed wiring boards are separated along the joined aluminum surfaces of the outer layers after the laminating process, the separated aluminum surfaces are free from foreign matter and hence clean, and do not need to be polished prior to the photo-imaging of outer layer circuit.

In the above embodiment, the manufacture of a four-layer printed wiring board is described. However, the present invention is also applicable to the manufacture of a multiple printed wiring board of six or more layers.

With the present invention, as described above, the cost of manufacture can be reduced, the process can be automatized, and the product quality can be improved in the process of laminating multilayer printed wiring boards.

Claims

1. An outer layer material for a multilayer printed wiring board, comprising first and second plastic-metal-copper foils each composed of copper and a plastic metal such as an aluminum alloy, copper, brass, soft iron, a lead alloy, or the like, said first and second plastic-metal foil sides being integrally joined together, with surfaces of the plastic metal being separable from each other.

2. An outer layer material according to claim 1, wherein said surfaces of the plastic metal are joined by an adhesive or under pressure with heat, with a bonding strength which weakens at a predetermined temperature, or spot welding.

3. A method of manufacturing a multilayer printed wiring board, comprising th steps of:

stacking a first outer layer material according to claim 1, a first prepreg, an inner lay r laminate having wiring patterns on both surfaces thereof, a second prepreg, and a second

outer layer material according to claim 1, in the order named, thereby producing a stacked assembly;

pressing the stacked assembly to laminate with heat; and

separating said first and second outer layer materials along said surfaces of the plastic metal, thereby fabricating a multilayer printed wiring board.

4. A method of manufacturing a multilayer printed wiring board, comprising the steps of:

stacking a first outer layer material according to claim 1, a first prepreg, a first inner layer laminate having wiring patterns on both surfaces thereof, a second prepreg, a second outer layer material according to claim 1, a third prepreg, a second inner layer laminate having wiring patterns on both surfaces thereof, a fourth prepreg, and a third outer layer material according to claim 1, in the order named, thereby producing a stacked assembly;

pressing the stacked assembly to laminate with heat;

separating said first, second, and third outer layer materials along said surfaces of the plastic metal;

fabricating a multilayer printed wiring board as a first page, which is composed of a portion of said first outer layer material, said first prepreg, said first inner layer laminate, said second prepreg, and a portion of said second outer layer material; and

fabricating a multilayer printed wiring board as a second layer page, which is composed of a portion of said second outer layer material, said third prepreg, said second inner layer laminate, said fourth prepreg, and a portion of said third outer layer material.

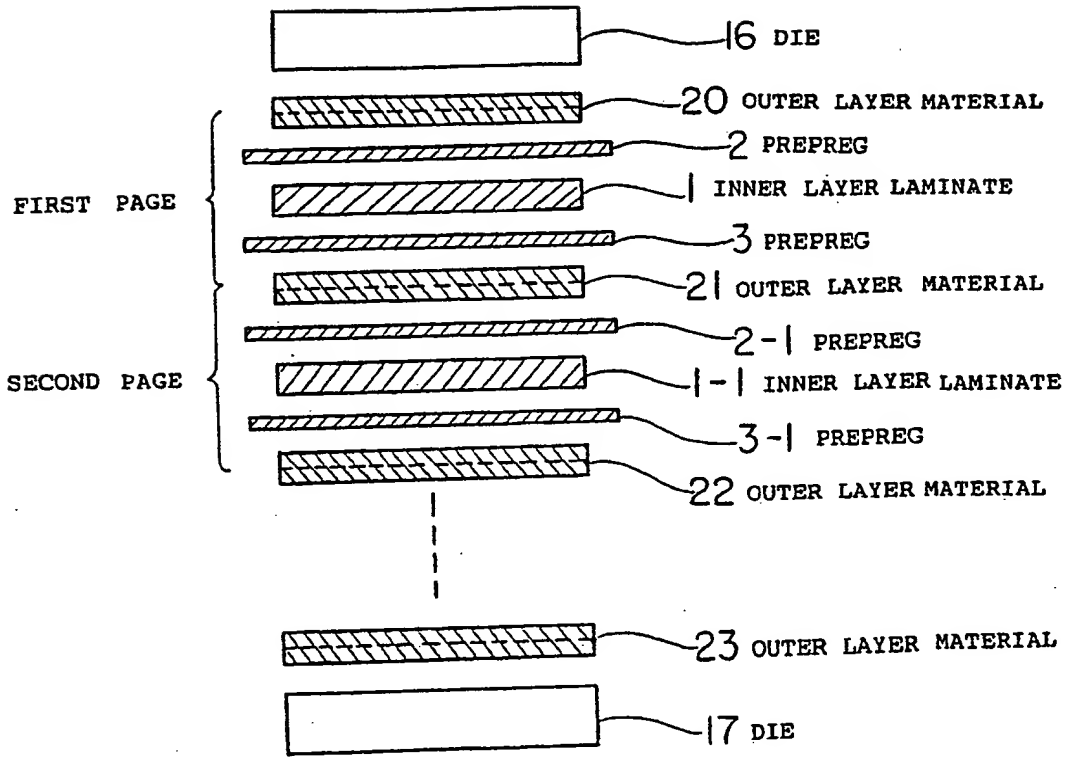
16 DIE
20 OUTER LAYER MATERIAL
2 PREPREG
1 INNER LAYER LAMINATE
3 PREPREG
21 OUTER LAYER MATERIAL
2-1 PREPREG
1-1 INNER LAYER LAMINATE
3-1 PREPREG
22 OUTER LAYER MATERIAL
FIRST PAGE
SECOND PAGE
23 OUTER LAYER MATERIAL
17 DIE

Fig. 1

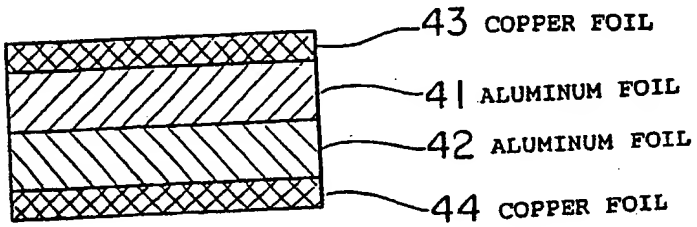
43 COPPER FOIL
41 ALUMINUM FOIL
42 ALUMINUM FOIL
44 COPPER FOIL

Fig. 2

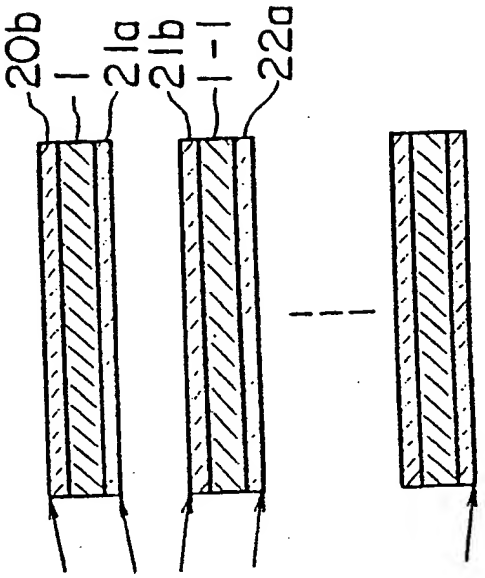

Fig. 4

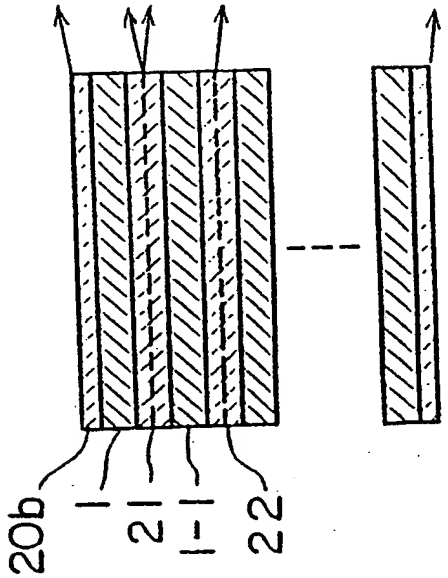

Fig. 3

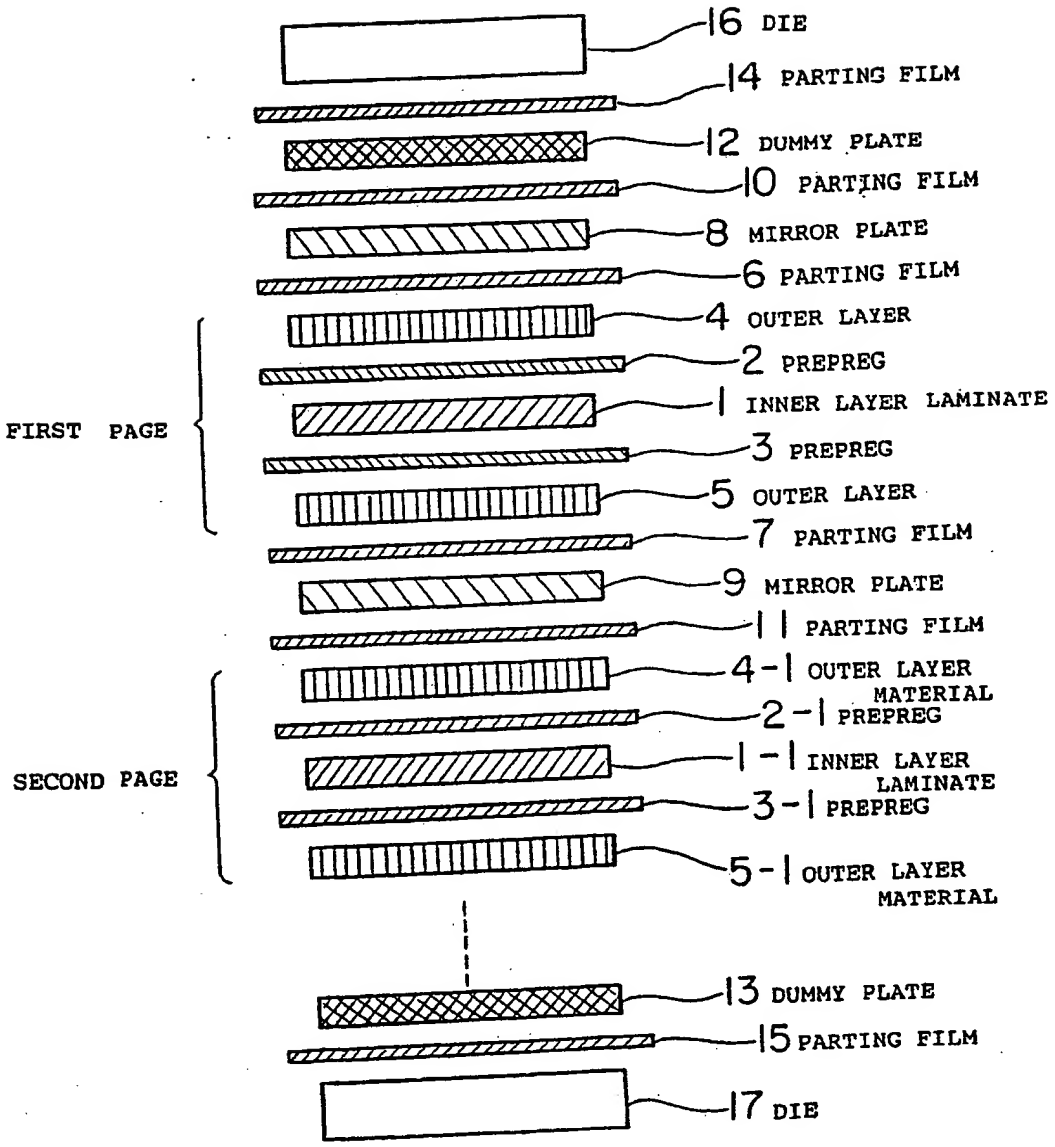
16 DIE
14 PARTING FILM
12 DUMMY PLATE
10 PARTING FILM
8 MIRROR PLATE
6 PARTING FILM
4 OUTER LAYER
2 PREPREG
1 INNER LAYER LAMINATE
3 PREPREG
5 OUTER LAYER
7 PARTING FILM
9 MIRROR PLATE
11 PARTING FILM
4-1 OUTER LAYER MATERIAL
2-1 PREPREG
1-1 INNER LAYER LAMINATE
3-1 PREPREG
5-1 OUTER LAYER MATERIAL
13 DUMMY PLATE
15 PARTING FILM
17 DIE
FIRST PAGE
SECOND PAGE

Fig. 5

INTERNATIONAL SEARCH REPORT

International Application No PCT/JP90/00132

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl[5] H05K3/46

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	H05K3/46

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

Jitsuyo Shinan Koho	1969 - 1989
Kokai Jitsuyo Shinan Koho	1974 - 1989

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	JP, A, 56-78199 (Fujitsu Ltd.), 26 June 1981 (26. 06. 81), Column 3, lines 2 to 20, column 4, lines 1 to 20	1,2,3,4
Y	JP, A, 62-232997 (Isola Werke A.G.), 13 October 1987 (13. 10. 87), Column 13, lines 6 to 8 (Family: none)	1,2,3,4
Y	JP, A, 60-206088 (Hitachi Chemical Co., Ltd.), 17 October 1985 (17. 10. 85), Column 2, lines 19 to 20, column 3, lines 1 to 6 (Family: none)	3
Y	JP, A, 58-30195 (Toshiba Chemical Corp.), 22 February 1983 (22. 02. 83), Column 5, lines 2 to 17	3, 4

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
March 8, 1990 (08. 03. 90)	March 26, 1990 (26. 03. 90)
International Searching Authority	**Signature of Authorized Officer**
Japanese Patent Office	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

Y	JP, A, 61-277428 (Ashida Seisakusho Kabushiki Kaisha), 8 December 1986 (08. 12. 86), Column 14, lines 6 to 14 (Family: none)	4

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers . because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers . because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers . because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.